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Fertilizing

Ohio Farms

Agricultural Extension Service
Ohio State University

Ohio Fertilizer Recommendations

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Liberal Fertilization Boosts Yields and Income Farmers who have good crop yields and good livestock production have the highest incomes. Good yields call for liberal uses of fertilizers year after year.

You can make more profit from crops by applying at least 250 pounds or more fertilizer an acre each year. You need to put the heavier applications on the more responsive crops. Fertilizing for a new meadow or green manure crop is important.

You will profit by fertilizing regularly all permanent pastures and the meadows used for hay, silage and pasture. The quality and yields of sod crops can be kept high with proper fertilization. Other management practices must also be good.

Fertilization Works Better With Good Management You will receive best returns from fertilizers if the lime, drainage and organic matter needs of crops are supplied. Most field crops, especially alfalfa and sweetclover, do best if soils have a pH of 6.5 to 7.0 The pH level of your soil is reported when you send a soil sample for testing. See your county agent about soil tests.

Let's take another example . . . manure. The farmer who handles and stores manure carelessly loses much potash and nitrogen. To get the most from manure, haul it directly from the stable to the land or store it under cover. Each ton of protected manure equals about 100 pounds of 10-5-10 fertilizer.

Five to eight loads of manure per acre applied as a top-dressing on wheat in the fall and winter, will boost the growth of meadow and green manure crop seedings, especially on less productive, light-colored soils. Top dressing reduces erosion on sloping land. Where wheat frequently lodges, use only strawy manure.

Keep Nutrients at Home On sloping land strip cropping, planting row crops on the contour and terracing help hold soil water, organic matter, lime and fertilizer in place. Thick-growing sod crops are the backbone of conservation farming, but they alone cannot do the job on rolling or hilly lands. Legume-grass sods or green manure crops provide the best way of renewing good soil structure or tilth and are especially valuable on heavy soils.

Replace Nutrients Removed by Crops Sometimes it is difficult to keep nutrients at home. A cash grain farmer may remove straw after grain harvest to help a new seeding. Mineral nutrients removed in the straw per acre equal those found in about 120 pounds of 0-10-30. Each ton of alfalfa hay removes about 10 pounds of phosphoric acid (P_2O_5) and 40 pounds of potash (K_2O).

How Grades Are Figured Fertilizers are sold by grades. Grade is expressed by a series of figures. 4-16-8 means 4 percent of nitrogen, 16 percent of phosphoric acid (P_2O_5) and 8 percent potash (K_2O).

Recommended Ratios and Grades

Ratios	Minimum Grades	Higher Analysis Grades
0-1-1	0-14-14	0-20-20 and 0-16-16
0-1-2	0-10-20	0-10-20
0-1-3	0-10-30	0-10-30
0-2-1	0-20-10	0-20-10
1-1-1	10-10-10	12-12-12
1-4-4	8-12-12	4-16-16
1-3-6	3-9-18	3-9-18
1-2-2	6-12-12	8-16-16
1-2-3	5-10-15	5-10-15
2-1-1	14-7-7	14-7-7
1-4-2	4-16-8	5-20-10 and 6-24-12

Equivalent use of higher analysis grades is satisfactory and most economical.

In 1953 the minimum grades were: 0-1-1 ratio 0-12-12, 0-1-3 ratio 0-9-27, 1-1-1 ratio 8-8-8, 1-2-2 ratio 5-10-10, 2-1-1 ratio 12-6-6.

Get Fertilizers Early The fertilizer manufacturer mixes the materials for the desired grade and puts the mixture in a bin to cure. Fertilizers should be removed from the bin as soon as the curing is complete so that a new batch can be mixed and cured.

Farmers should order fertilizers early, accept delivery at any time and store the fertilizer on the farm until needed.

The industry can then do a better job of getting fertilizers to the farm when they are wanted. The farmer stands a better chance of getting the grade he wants in times of heavy demand.

Farm Storage of Fertilizers Store fertilizer in a dry, well ventilated building. Good air circulation around the bags is necessary. If the floor is concrete or earth, put bags on platforms 1 foot or more above the floor. Not over 6 to 8 bags should be piled on top of each other.

If piles are left for a considerable time the bags should be repiled and those on the bottom put on the top.

Soil Tests Reveal Special Needs Soil tests take stock of the plant foods in your fields. Soil tests show what fertilizer ratios are needed. The test will tell you where you need to build up a reserve of one or more plant foods. When P_2O_5 and K_2O tests are high, less fertilizer is needed on corn and small grains.

Use the soil testing service of the Agricultural Extension Service, Ohio State University, available through your County Extension Agent. Get directions for taking soil samples and take the samples to the County Extension Agent well in advance of the time of ordering fertilizers. There is a small fee for this service. The laboratory is very busy just before planting time. It may be a month before you get the results of the tests and the recommendations during the busy period.

Can Plant Nutrients Be Stored in Soil? Phosphoric acid can be stored in the soil with little loss except by removal in harvested crops. Experiments indicate that once the phosphorus level of most Ohio soils has been raised to a medium status, an application of 45 to 50 pounds per acre of P_2O_5 per acre per year during the rotation is satisfactory and profitable.

Potash can also be stored in the soil without serious loss from leaching. Legumes take much more potash from the soil than other field crops, but they have higher yields and live longer when the supply of soil potash is kept high. When soil has an excess of potash, legumes take more than they really need. However, most of the potash in legumes is returned in manure when the legume crop is fed on the farm.

It is recommended that potash be applied to legumes every year instead of in one large application. To save potash, leave crop residues on the field and protect manure from leaching.

Nitrogen is difficult to store in the soil. Usually mineral nitrogen can be held only after it is combined in the soil organic matter. The organic matter releases nitrogen as it decomposes. Mineral nitrogen applied in comercial fertilizers usually has its effect within the growing season of its application. Effects are noticeable within a very short time. When extra production is needed, apply nitrogen to grass meadows and pastures. Farmers must use their judgment about applying nitrogen fertilizers on oats and wheat which may lodge.

Prevent Nitrogen Deficiency Organic materials applied or left on the field supply food for soil organisms. The bacteria require nitrogen. Bacteria working on organic materials low in nitrogen such as corn stalks, straw and grass sods use whatever nitrogen is available. The growing crop may lack nitrogen. It is usually profitable to apply commercial nitrogen to corn and grain crops when these crop residues are turned under or left on the soil.

Limit nitrogen and potash applications near seeds. Nitrogen and potash materials mixed in fertilizers are water-soluble. They may cause injury if applied in large quantities too close to the seed or plant, especially when soil is dry.

Using High Analysis Fertilizers Fertilizer applications in the row must not exceed safe rates for nitrogen and potash. Broadcast applications of fertilizer high in nitrogen should be plowed down or disked in deeply after plowing on corn land. P_2O_5 and K_2O are of little benefit to corn when plowed down or disked in deeply, except on soils deficient in these materials.

High analysis fertilizers may be used on meadows and pastures. Nitrogen is needed where the sod is mostly grass. Legume stands need P_2O_5 and K_2O.

Effects of Nitrogen On Soil Acidity Nitrogen materials vary in their effects on soil reaction (acidity). The residual effects of various forms of nitrogen fertilizers in terms of limestone ($CaCO_3$) per 20 pounds of nitrogen applied is given as minus (—) indicating acid and (+) indicating basic reaction in the following tables.

Solid Materials	Ammonia Nitrogen	Nitrate Nitrogen	Total Nitrogen	Calcium $CaCO_3$ Equivalent per 20 lb. Nitrogen
Ammonium Sulfate	20 6	——	20.6	—107
Ammonium Nitrate	16.5	16.5	33	— 36
Ammonium Nitrate and Limestone Mixtures	10.25	10 25	20.5	——
Cyanamid	21	——	21	+ 57
Urea Compounds	42-45	——	42-45	— 36
Nitrate of Soda	——	16	16	+ 36

Nitrogen solutions containing ammonium nitrate or urea can be handled satisfactorily in aluminum and stainless steel, but are slightly corrosive to iron and steel and corrosive to brass and bronze.

Volatile ammonia in solution may be lost in the air unless placed 4 to 6 inches below the surface and well covered. A plow attachment may be used for application.

Nitrate nitrogen applied to the soil goes into solution but is not absorbed by soil particles. Therefore it moves with the soil moisture. If rains are heavy and soil water moves down and then away as drainage water, some nitrate nitrogen goes with it. Such movement is greater on light than on heavy soils. If the season is dry and water moves up in the soil, nitrates also move up and are deposited near the surface by evaporation. These nitrates are available again for plant use when sufficient rainfall carries them back into the root zone. Materials containing nitrate nitrogen, therefore, should be applied only during or immediately prior to the growing season.

Ammonium nitrogen applied to the soil goes into solution and is rapidly fixed by clay particles until it is taken up by growing plants or changed to nitrate nitrogen by soil bacteria. This change to

Solution Materials	Volatile Ammonia Nitrogen %	Ammonia Nitrogen Not Volatile %	Nitrate Nitrogen %	Total Nitrogen %	Calcium $CaCO_3$ Equivalent per 20 lb. Nitrogen	How to Apply
Anhydrous Ammonia	82.0	——	——	82.0	—36	Apply in Soil
Nitrogen* Solutions		10.0	7.0	21.0		
with no Volatile		to	to	to		Apply in or
Ammonia	None	25	11	32.0	—36	on Soil
Nitrogen* Solutions	13.0	9.0	9.0	37.0		
with Volatile	to	to	to	to		
Ammonia	22.0	12	12	41	—36	Apply in Soil

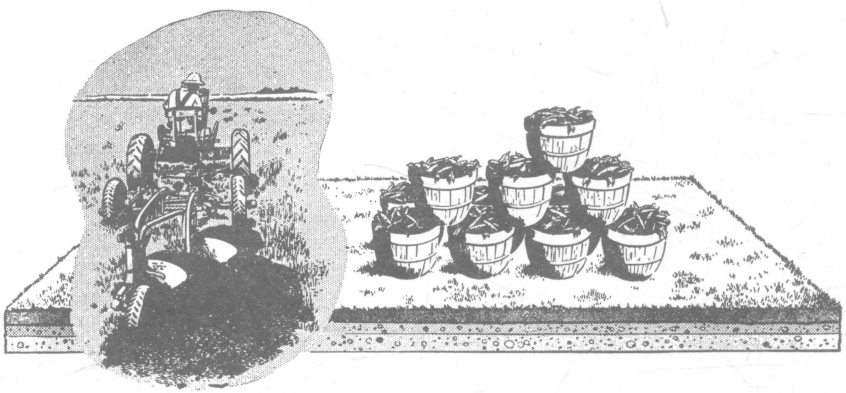
* Two or more solutions in each group. Upper and lower limits of analyses given.

nitrate nitrogen occurs only when soil is warm, moist and well aerated. Therefore, ammonium nitrogen can be applied in the late fall, winter or early spring with little loss by leaching.

Urea and cyanamid are synthetic forms of nitrogen. In the soil formation of ammonia nitrogen from either material occurs within a few days. Cyanamid should not be applied close to germinating seeds, plant roots or in band applications. Cyanamid can be used as a spring top-dressing for wheat and grass if applied before growth begins.

Fitting Nitrogen To Rotation There is a place in crop production for all these forms of nitrogen. Growing plants can use either ammonia or nitrate nitrogen. Ammonia or nitrate forms can be used in starter fertilizers at planting time. Use either ammonia, urea or cyanamid form for late fall or winter or early spring applications. Ammonia, nitrate and urea forms are equally satisfactory for plow-down applications just prior to planting for top-dressing small grains or grasses in meadows and pastures.

Anhydrous ammonia and nitrogen solutions may be substituted for dry forms of nitrogen in amounts to equal the nitrogen in dry forms. In side dressing corn with anhydrous ammonia or nitrogen solutions apply 10 to 12 inches on one side of the corn row and before the corn is 6 to 8 inches tall.



Fertilizer Treatments for the Important Crops

Fertilizer recommendations in this bulletin are higher than average applications on Ohio farms. They are not the highest applications that can be profitable when other conditions are satisfactory for good yields.

Corn Apply at least 300 to 400 pounds of standard grade fertilizer on each acre of drilled corn. Limit hill applications to 150 pounds per acre. When soil is dry, row applications should not exceed 60 pounds of nitrogen and potash or a combination of the two. Heavier applications have been made without damage when the soil moisture content was above normal. Use grades 3-12-12, 4-16-8, 6-12-12 and higher analysis grades. On sandy, muck and peat soils use 3-9-18.

Apply 60 to 100 pounds or more of extra element nitrogen except when corn follows good legume sods or when at least 8 to 10 tons of manure (not strawy) are applied on each acre of corn ground. This is especially important when corn follows corn or soybeans (residue left on the field) grass sods, etc.

Broadcast nitrogen fertilizers before plowing or sidedress after corn starts growing. Avoid deep sidedressing close to corn to reduce root cutting. Use heavier applications where rate of planting is adequate, soil tilth favorable and nitrogen supply is likely to be short.

Plant at least 15,000 seeds per acre when expecting 90 to 100 or more bushels of corn. **Drop a kernel each 8 to 10 inches in rows 40 to 42 inches apart.**

Fifty pounds of nitrogen per acre can be supplied by using 250 pounds of sulfate of ammonia or cyanamid, 150 pounds of ammonium nitrate, 325 pounds of nitrate of soda or equivalent of other nitrogen carriers.

Fertilizing Small Grain Apply at least 400 to 500 pounds an acre of 3-12-12, 4-16-8 or equivalent amounts of other grades. Use 3-9-18 on sandy, muck and peat soil. Use 0-20-20 or 0-20-10 on productive soil and on early seeded wheat that may lodge.

When wheat has a poor growth in the spring, apply 20 to 30 pounds of nitrogen per acre. This is most likely to be needed on the less productive soils and for late seeded wheat following corn or soybeans. Broadcast fertilizer in March in southern Ohio and March 1 to April 15 in northern Ohio.

On soils that have not been adequately fertilized and limed in the past, an application of a complete fertilizer on the wheat in the spring may mean a better stand of the new seeding. This is especially important where the rate of fertilization of wheat in the fall is inadequate. Two hundred to three hundred pounds of 10-10-10 may be used when a need for nitrogen is clearly indicated. Otherwise, 5-10-10 or 3-12-12 is suggested.

When oats usually make poor growth and the variety is not apt to lodge, use 20 to 30 pounds of nitrogen fertilizer per acre. Plow under or apply at seeding time 10-10-10 or other grades high in nitrogen.

Fertilizing Meadow Crops Use fertilizers recommended for grain crops on new seedings planted without a nurse crop.

New Seedings in Wheat—When seeding in wheat with a disk drill, apply 200 pounds of 0-20-0 an acre with the legume seed. Or use 175 to 200 pounds of 0-14-14 or 0-20-10, but do not exceed 25 pounds of potash per acre. Broadcast legume seed if the wheat is growing fast and wet soil prevents drilling.

Band Seeding — When seeding with oats or without a companion grain crop, arrange the hose or tubes from the seed box to drop the legume seed 10 to 12 inches back of the discs and directly over the band of fertilizer and oats. You gain nothing if seed drops one-half inch or more to one side of the fertilizer.

Established alfalfa hay or pasture needs fertilizer high in potash. Use 300 to 400 pounds per acre of 0-10-20, 0-10-30, or 0-20-20 yearly when meadow is to be kept another year. This increases yield and lengthens life of the stand when other management practices are good. Apply in early fall, spring or after any harvest.

Bluegrass pastures require an initial treatment of 400 to 600 pounds per acre of 0-20-10 or 0-20-0. Apply the same amount of 0-20-10 or 0-14-14 every second or third year later. Use 0-20-0 if the field is completely manured.

To advance spring grazing and increase spring growth, apply 40 to 60 pounds of nitrogen per acre on fair to good sods in fall, winter, or early spring. Treat one-third to one-half acre for each cow to be grazed. If all nutrients are needed the same year, use 500 pounds per acre of 10-10-10 or 14-7-7.

Timothy or other grass meadows need phosphorus and potash as do permanent pastures. To increase yields, apply 40 to 60 pounds of nitrogen an acre in fall, winter, or early spring. Nitrogen fertilizers also increase grass seed production.

Soybeans respond least of all crops to direct applications of fertilizer. However, they will benefit if more fertilizer is applied on other crops in the rotation. For direct application, use 200 to 300 pounds of 0-14-14 on an acre but avoid contact of seed and fertilizers.

Fertilizing Sugar Beets For most growth of sugar beets the soil should have: (a) water holding capacity above that of average soil; (b) granular texture that holds under good management in plowing and fitting the seedbed; (c) sufficient lime to assure a reaction of not less than pH 6.5. Soils possessing these qualifications are the dark colored clays, clay loams, silty clay loams and loams.

Best place for beets in a rotation is following a 2-year old legume-grass sod.

Fertilize in the row with 300 to 400 pounds of 3-12-12, 6-12-12 or 4-16-8 an acre. Use 3-9-18 on muck soils. If more nitrogen is needed, broadcast and plow under 60 to 80 pounds an acre or 600 to 800 pounds of 10-10-10.

Fertilizing Tobacco On continuous tobacco, apply 500 to 600 pounds of 3-12-12, 4-16-8 or 6-12-12 an acre with the cover crop.

For tobacco in the rotation, fertilize liberally on all crops in the rotation with stress on the crop that preceeds tobacco. Or plow down phosphorus and (or) potash when plowing for either continuous or rotation tobacco as indicated by soil tests.

When phosphorus and potash levels are high, apply enough nitrogen to get top yields. Plow down 60 to 80 pounds of nitrogen per acre or 8 to 10 tons of manure with cover crops or grass sods.

Use 400 to 600 pounds an acre of 5-10-15 in the row. This fertilizer must not come in direct contact with the tobacco plants. At least one-half of the potash applied in tobacco fertilizers should be in sulfate form.

Fertilizing Tomatoes Broadcast 600 to 1200 pounds of fertilizer an acre before plowing or drill deeply after plowing. On highly fertile soils or where legumes have been grown regularly, use 3-12-12. Apply 6-12-12 or a similar grade on light colored soils, where few legumes have been grown or where no manure has been applied. On light colored soils where corn stalks, straw or other low nitrogen materials are plowed under, use 500 to 700 pounds of 10-10-10 an acre. Maximum applications are recommended only for soils in good tilth.

Response from sidedressing with nitrogen is erratic and generally not recommended. If made, however, apply 20 to 30 pounds of nitrogen (100 to 150 pounds of ammonium sulfate or an equivalent) at last cultivation. Such applications may help on sandy and light colored soils or where large amounts of organic material low in nitrogen have been plowed under.

In case of direct seeded tomatoes, apply 200 to 300 pounds of 0-14-14, 3-12-12 or similar grade in the row, two inches below the seed. When transplanting, dissolve a starter fertilizer in the transplanter water. Select a high phosphorus fertilizer like 10-52-17, 13-26-13, 15-30-15. If similar materials are used, follow the manufacturers' directions.

Trace Elements Needed in Some Locations With localized exceptions, most Ohio soils soils contain sufficient minor or trace elements for good crop growth. In the lake bed soils of northwestern Ohio, some soybean fields reveal a manganese deficiency. Soybean leaves first turn light green then to a yellowish green. In severe cases, brown patches of dead tissue appear on the lower leaves.

Manganese deficiency may be corrected by spraying an acre of beans with 10 pounds of spray grade manganese sulfate in 40 to 80 gallons of water when the bean leaves begin to discolor.

Manganese deficiency may also be prevented by mixing 20 to 30 pounds of manganese sulfate with the fertilizer applied to each acre of soybeans. The fertilizer should not come in contact with the beans.

Soybeans give the best indication of a manganese deficient soil. Your county agricultural agent has information concerning the materials to be used, rates of applications, and crops on which applications should be made.

Correct manganese deficiencies in oats and wheat by using the spray treatment recommended for soybeans.

Building Reserves Of P_2O_5 and K_2O Building reserves of P_2O_5 and K_2O is recommended when soil tests reveal the amounts of these are low. Make recommended applications for corn (in row), wheat, oats, meadows, meadow pastures, permanent pastures and other crops. Additional applications may be made as follows:

1. Fertilize meadows and meadow pastures more liberally than in the past. Apply the seeding year after grain harvest and each year until the meadow is plowed, in the early fall, spring or after any harvest. If desired, use bulk applications.
2. Plow under fertilizer for corn. If this cannot be done, disk in deeply after plowing.
3. Build mineral reserves every 4 to 5 years by these applications:

Soils—Low in P_2O_5 and high in K_2O: Use 160 pounds of P_2O_5 an acre. Medium in P_2O_5 and low in K_2O: Use 80 pounds of P_2O_5 and 200 pounds of K_2O an acre. Low in P_2O_5 and medium in K_2O: Use 160 pounds of P_2O_5 and 100 pounds of K_2O an acre. High in P_2O_5 and low in K_2O: Use 200 pounds of K_2O an acre.

Continued high productivity is more certain when the soil has an abundant supply of available P_2O_5 and K_2O. This may prevent a deficiency of an element which would decrease yields.

Continued applications of this kind will, in time, build up a reserve in the soil. There is evidence that when this occurs, the applications of fertilizer at planting may be reduced.

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